① Mac Master
October 29, 1977

McMASTER UNIVERSITY
Department of Biology
1280 Main Street West, Hamilton, Ontario L8S 4K1
Telephone (416) 525-9140

July 4, 1977.

Dear

At the recent meetings of the Botanical Society we discussed the possibility of holding a one day meeting on plant development. The idea behind this was that we could present papers and develop some interactions between people working in the area of plant development.

The papers could be of several types:

1. reports of data from more or less completed studies
2. reports of on-going research presented with the aim of defining problems that had been encountered and obtaining in-put from colleagues in related areas
3. discussion papers that are designed to draw attention to i) areas that should be examined or ii) approaches that are currently neglected.
4. position or theoretical papers on areas of interest

My suggestion that we should limit these meetings to people working around Toronto is not an attempt to exclude anyone in other parts of the province; rather it is an attempt to limit the distances people might expect to travel to a meeting. Thus, if we confined these meetings to Toronto, McMaster, Brock, Western and Guelph, we could all reach the department acting as host for a meeting within 2 hours. This way, we could have the meeting on one day between 10 a.m. and 5 p.m.

One hope I have for such meetings is that we could work at an integration of different approaches i.e. morphological, anatomical, cytological, genetical, biochemical and physiological. The people I have approached so far are: Greyson, Walden, Dengler and Lott. They are all

continued ...

experts in particular branches of development. For fruitfull meetings for us, and for our students, we should be willing to "give" and to see other approaches to such an extent that interactions do occur. Part of that approach could come from position papers or papers that direct attention to difficult areas. Another approach would be for us to attempt to define what we consider to be the important principles of plant development and for us to identify areas of research, or problems, that provide good examples of developmental processes in plants. In this context I would ask you to think about putting down on paper the main points that you think should be brought out in a course on plant development.

I suggest that we might try to meet in late October or early November.

The ideas that are sketched out here are mine; they are not binding and they are not intended to lay down ground rules for any meetings that do take place. The form of the meetings will be decided by the people who participate.

I should be glad to arrange a trial meeting, if you are interested. I suggest that there should be no registration fees or anything like that. We may, later, have to consider charges for xeroxing, abstracts, but we can meet that challenge when it arises.

If you are interested, please let me know as soon as possible. I shall look forward to hearing from you.

Yours sincerely,

D. Davidson.

DD/jk

1977

①

McMaster University
Department of Biology

Dear Mary

The workshop on plant development that we have discussed will be held on Saturday, October 29th. We will meet in the Life Sciences Building at McMaster. A flyer is enclosed.

In my original letter I asked everyone to give some thought to putting down on paper the main points that should be brought out in a course on plant development. This could be useful, since it would define areas and approaches - besides pointing to problems. It would also be useful as a framework in which we could hold discussions. No one has sent me any notes, as yet. If you could put some points together I shall try to integrate them.

A number of you have suggested that we should include our colleagues from places as far away as Ottawa and Sudbury. I am quite happy to do this, though it may defeat the original aim of holding the meetings in a restricted area so that we can get there and back in a day.

I am now asking for abstracts. I look forward to a good response from faculty and graduate students. However, I also hope that you have been giving serious thought to position papers. I look forward to hearing about them. Since the meeting does not have an organization to run it, please let me have your titles, abstracts as soon as possible.

With best wishes,

Douglas

D. Davidson,
Professor.

DD:mm

1977

WORKSHOP ON PLANT DEVELOPMENT

A one day workshop on plant development will be held on SATURDAY, OCTOBER 29th. The meeting will be held in the Life Sciences Building of McMaster University.

Sessions 9:30 a.m. - 12:00 noon

Times 1:30 p.m. - 5:00 p.m.

Title and Abstracts

Please submit titles and abstracts as soon as possible, but no later than October 22 to:

Dr. D. Davidson,
Biology Department,
McMaster University,
HAMILTON, Ontario L8S 4K1

Papers should be timed to last 15 minutes. Abstracts should be typed; an abstract should not be less than 250 words length (if you could type it to fit inside a space 17 cm x 12 cm this would help in the process of duplicating it.

November 3, 1977.

Dr. J.K. Morton,
Department of Biology,
University of Waterloo,
Waterloo, Ontario N2L 3G1

Dear Dr. Morton:

Thank you for your letter. The one day workshop in plant development that I had mentioned to you in my previous letter was held last week. It was a very enjoyable meeting and seems to have been successful and productive.

I am sending you, with this letter, a copy of the programme, the abstracts of the papers and an account of the meeting. You are free to use as much or as little of the material as you please for the Bulletin. However, I hope that you will be able to use at least some of the material I enclose since the future viability of these workshops will be helped if the CBA Bulletin can give them some recognition and notice.

The participants agreed to meet again next spring. Dr. R.I. Greyson agreed to organize another workshop in the first two weeks of April; it will be held at the University of Western Ontario. Dick Greyson should be in touch with you in the near future.

If you need additional information about the workshop please let me know and I shall do my best to let you have it.

Yours sincerely,

D. Davidson,
Professor of Biology.

DD:mm

THE CANADIAN BOTANICAL ASSOCIATION
Founded 1964

L'ASSOCIATION BOTANIQUE DU CANADA
Fondée en 1964

Biology Department
University of Waterloo
Waterloo, Ontario
N2L 3G1

November 8, 1977

Dr. D. Davidson
Department of Biology
McMaster University
1280 Main Street West
Hamilton, Ontario
L8S 4K1

Dear Dr. Davidson:

Thank you for the information about the workshop on plant development. I am glad to hear that it was a success. I will publish an account of the meetings in the January issue of the Bulletin. I will also consider the possibility of publishing the abstracts, but it may be that these will add too much to the size of that issue.

Yours sincerely,

John K. Morton

J.K. Morton
Editor
CBA Bulletin

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LAURENTIAN UNIVERSITY UNIVERSITÉ LAURENTIENNE

SUDBURY, ONTARIO, CANADA
P3E 2C6

DEPARTMENT OF BIOLOGY
DÉPARTEMENT DE BIOLOGIE

9 September 1977.

Dr. D. Davidson,
Department of Biology,
McMaster University,
1280 Main Street West,
Hamilton, Ontario.
L8S 4K1

Dear Dr. Davidson,

Thank you very much for sending me information on your proposed meetings with the theme of plant development. Although I am Laurentian's "Entomologist", part of my research is in the field of plant development and therefore I would be very interested in attending and contributing to your meetings. I am not sure whether or not I will be able to attend your late October meeting since I am scheduled to present two papers near the end of this month, however, I would appreciate receiving information concerning all your meetings.

My research is in the field of plant galls but besides studying the ecology of inhabitants, I am also examining gall development, influence of various parasitic inhabitants on gall development, and gall physiology. Research in conjunction with the use of insect galls in the biological control of weeds. We are in the process of studying the developmental morphology of eight species of gall formers that attack various thistles. We have evidence that galls without parasites act as strong physiological sinks thus reducing both the vigour and number of seeds produced by their hosts.

One of my graduate students is studying the physiology of two galls, one found on the leaves of dandelion and the other on the stems of Canada thistle.

I look forward to discussing this research and the problems we have encountered with you and your colleagues.

Sincerely yours,

Joe D. - Shorthouse

J.D. Shorthouse,
Assistant Professor.

JDS/sdh

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WORKSHOP ON PLANT DEVELOPMENT

A one day workshop on plant development will be held on SATURDAY, OCTOBER 29th. The meeting will be held in the Life Sciences Building of McMaster University.

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CBA/ABC SPONSORSHIP OF LOCAL OR REGIONAL ONE-DAY WORKSHOPS

Your Executive wishes to encourage the membership (student as well as regular) to organize one-day workshops on specific botanical topics for the benefit of CBA/ABC members (and invited non-members) at their own university or government laboratory and those at nearby (100-200 km.) universities or government laboratories. These workshops are for the purpose of promoting discussion of on-going and projected research by staff and students with some time devoted to discussion of plants and pertinent techniques, as well as of hard data and firm conclusions, and to do this in a less-formal manner than at the Annual Meetings.

Organizers of such workshops can do the Association a service by publicizing them as CBA/ABC-sponsored activities and using them to promote new memberships.

Provided such workshops are held at a time and place that doesn't conflict with the Association's annual meeting, that CBA/ABC members in the locale or region in question are notified in advance (so they have a chance to attend if they are interested) and that a notice and report are published in the *Bulletin*, your Executive feels that they will help to promote interest in the Association and should be designated and publicized as CBA/ABC workshops.

To obtain approval for a one-day CBA/ABC workshop the following guidelines will apply; Organizer(s) should:

(1) Write to the President of CBA/ABC (copies to the Secretary and Editor of the *Bulletin*) for approval, enclosing a copy of the Notice intended for publication in the *Bulletin* (deadlines -- 1st of December, March, June and September for publication in the January, April, July and October issues respectively).

(2) Request the Editor to send him the CBA/ABC membership address list. This may be available on individual gummed labels.

(3) Select the addresses of all members in the locale or region in question and send them a copy of the Notice.

(4) Undertake to submit a small report on the highlights of the workshop, including the attendance, to the Editor (copies to the President and Secretary) for publication in the *Bulletin*.

(5) Actively solicit memberships in CBA/ABC at the Workshop or meeting.

PLANT DEVELOPMENTAL WORKSHOP

At the 1977 annual meeting, in Winnipeg, it was decided to hold an informal workshop in plant development sometime towards the end of the year. The objective was to bring together workers interested in this area and, it was hoped to stimulate interaction between them. The first workshop was held on 29 October and was organized by Dr. D. Davidson (McMaster University).

In the initial discussions, it was decided to limit the meeting to one day and to hold it at a central location, in order to minimize the time spent in travelling. The first notices for the meeting, therefore, were sent to universities in southeastern Ontario; subsequently, notices were also sent to Carleton and Lakehead. The response to the notices was enthusiastic and the first workshop was held on 29 October in the Biology Department at McMaster; 36 people attended.

The papers presented in the two sessions, 9.20 to 12.30 and 2.00 to 4.30 were as follows:

1. Dr. R.L. Peterson. Root cap structure in the fern, *Ophioglossum*.
2. Dr. N.G. Dengler. The effect of light intensity on the processes of cell division and cell enlargement during leaf development.
3. Mr. J.E. Thomas. Nuclear growth in root cells during germination of *Vivia faba*.
4. Dr. U. Posluszny. Dichotomous branching in apical meristems.
5. Mrs. M. Scott. Development of the endodermis in *Ranunculus*.
6. Dr. W. Newcomb. Development of nitrogen-fixing root nodules.
7. Mr. R.L. White. Differential growth of sister nuclei in binuclate microspores of *Tradescantia paludosa*.
8. Dr. R.I. Greyson and Dr. D.B. Walden. The ABPHYL syndrome in *Zea mays*.
9. Mr. S.W. Armstrong. Caffeine effects on cell proliferation in roots of *Vicia faba*.
10. Dr. W.E. Rauser, Mr. G.D. Hogan and Mr. A.B. Samarakoon. Phytotoxic burdens of heavy metal ions: relative tolerance in *Agrostis gigantea* and early responses in *Phaseolus vulgaris*.
11. Dr. R.F. Horton and Ms. J. Fregean. Growth regulations and assimilate transport.

Shoot meristem organization and how it changes during the initiation of branching was discussed by Posloszny, Greyson and Walden. Their data indicated how meristem structure would be affected by changes both in the relative spatial distribution of actively proliferating and non-proliferating cells and in the orientation of division. The sporadic occurrence of branching in *Flagellaria* (Posloszny) suggested genetic polymorphism for this character though it was clear from the ABPHYL syndrome that careful screening is necessary (Greyson and Walden).

Variation in rates of cell proliferation and cell enlargement were also considered during leaf development (Dengler). Difference in cell number and cell size occur in response to different light regimes and they underlie the morphological differences between leaves of sun and shade plants.

The onset of DNA replication and cell division was described for germinating roots of *Vicia faba* (Thomas). In the first cell cycle, which lasts about 70 hours, the cells show semi-synchrony and large nuclear volumes; subsequently roots revert to an asynchronous condition and this is accompanied by a reduction in nuclear volume. Cell progress through the first cell cycle is being followed using gel electrophoresis. Effect of physiological changes on cell proliferating and growth (Dengler and Thomas) were also considered from another aspect, that of infection. The onset of proliferation of root cells following infection with *Rhizobium* was described by Newcomb. He related cell proliferation to the invasion of root hairs by the microorganism and the subsequent stimulation of mitosis in nearby cortical cells. He also discussed the subsequent development of the nodule as a system engaged in nitrogen fixation.

Further evidence on nuclear growth in proliferating cells was provided for *V. faba* roots (Armstrong) and for microspores of *Tradescantia paludosa* (White). In the roots, binucleate cells were induced by treatment with caffeine. The proliferative ability of these cells was severely impaired by exposure to caffeine; only 10% of the cells underwent DNA replication and subsequently divided. Furthermore, mean nuclear volume showed a progressive reduction over 14 hours (Armstrong). Binucleate microspores were induced by heat shocks; the nuclei grew throughout interphase but the two sister nuclei did not grow at the same rate. The difference in mean volume between the larger and smaller nucleus of each cell suggested that differential growth was regulated by a nuclear factor, not by a difference in the cytoplasmic microenvironment of each nucleus (White).

The problems of gradients in cells, raised by some of the papers, was also implied in the analysis of cell-proliferation and development in the root cap of *Ophioglossum* (Peterson). Significant physiological changes occur over 2-3 cell cycles in the roots of this fern; they lead to the synthesis of starch and of polyphenolic compounds. A variety of techniques were applied in order to determine the site of synthesis of the phenolic compounds within cells and their mode of export (Peterson). This led to a discussion of differential gene activity in lineages of proliferating cells and to the question of the mode of synthesis of specialized components of cells' walls. This was analysed further in terms of the formation of the casparian strip of cells of the endodermis of roots of *Ranunculus*.

The mature endodermis of *Ranunculus* roots has a complex wall structure; it includes cellulose, suberin and lignin (Scott). The stages in the development of the tertiary wall complex was described from studies that have used SEM, TEM and histochemistry. The intracellular source of the wall components, their export and their mode of deposition were also described; the results illustrated the importance of the golgi apparatus in a regulated pattern of synthesis and export of the constituents used in the formation of specialized cell walls.

Physiological aspects of development were discussed in two papers. The basis of tolerance to heavy metals was studied by comparing the responses of different ecotypes of *Agrostis gigantea* to heavy metal treatments (Rauser, Hogan and Samarakoon); the results showed that neither differential binding of copper by root cell walls nor differential absorption could account for tolerance to copper. Parallel studies on leaves of *Phaseolus* showed that exposure to solutions of heavy metals resulted in an accumulation of sugars and starch; together with an increase in the level of soluble phenolic compounds.

Transport of photosynthetic assimilate was also discussed by Horton and Fregean. The part played by growth regulators in altering the rate of phloem translocation was tested using primary leaves of *Phaseolus vulgaris*; phloem translocation is one component of the postulated process of hormone directed transport of assimilate from leaves to sinks. Four growth regulators were tested; none had detectable effects on phloem translocation.

The papers stimulated considerable discussion, which was carried over into coffee and lunch breaks. In that respect, and in terms of bringing together a number of plant developmental biologists, the meeting was obviously successful. It also provided the opportunity for the presentation of one paper specifically designed to pose an experimental problem (Lott) and the response to that paper showed that an informal workshop has a great deal to offer in the way of discussion.

It was decided to meet again in April 1978. The forthcoming meeting will be held at the University of Western Ontario and will be organized by Dr. R.I. Greyson. Details of the April meeting will appear in a subsequent issue of the Bulletin.

D. Davidson

RESOLUTIONS

Resolutions for consideration at the next Annual General Meeting should be submitted to:- Dr. Janet Dugle, Secretary, CBA/ABC, Environmental Research, Whiteshell Nuclear Research Establishment, Pinawa, Manitoba, ROE 1LO. They should be submitted at least ten weeks prior to the meeting. Each resolution requires a mover and four seconders, all members in good standing of the CBA/ABC. To be admitted to the agenda, each resolution must specify to whom it will be addressed, and must be accompanied by a supporting brief. (See by-law 13 of our constitution).

MARY ELLIOTT SERVICE AWARD

The CBA executive has voted unanimously to establish a new award named in honour of the late Mary Elliott, president of the Association 1975-1976. This award is for meritorious service to the CBA/ABC and will be awarded at the annual meeting on a discretionary basis.

Nominations should be submitted to the chairman of the awards committee, Dr. Paul Gorham, Department of Botany, University of Alberta, Edmonton, Alberta T6G 2E9 by March 1, 1978. A citation of about 100 words should be included with the nomination.

Plant Developmental Workshop. 1977

9:30 a.m. Chairman: Dr. D. Davidson

McMaster University

1. The objective of a plant development workshop.
   Chairman's remarks.
2. Root cap structure in the fern, *Ophioglossum*.
   Dr. R.L. Peterson. University of Guelph.
3. The effect of light intensity on the processes of cell division and cell enlargement during leaf development.
   Dr. N.G. Dengler. University of Toronto.
4. Nuclear growth in root cells during germination of *Vicia faba*.
   Mr. J.E. Thomas. McMaster University.
5. Dichotomous branching in apical meristems.
   Dr. V. Posluszny. University of Guelph.
6. Development of the endodermis in *Ranunculus*.
   Ms. Martha Scott. University of Guelph.
7. Problems in experimental design.
   Dr. J.N.A. Lott. McMaster University.
8.

12:30 - 2:00 lunch

2:00 p.m. Chairman: Dr. J.N.A. Lott

McMaster University

8. Development of nitrogen-fixing root nodules.
   Dr. W. Newcomb. University of Guelph.
9. Differential growth of sister nuclei in binucleate microspores of *Tradescantia paludosa*.
   Mr. R.L. White. McMaster University.
10. The ABPHYL syndrome in *Zea mays*.
    Dr. R.I. Greyson and Dr. D.B. Walden. The University of Western Ontario.

11. Caffeine effects on cell proliferation in roots of Vicia faba.
    Mr. S.W. Armstrong. McMaster University.

12. Phytotoxic burdens of heavy metal ions: relative tolerance in Agrostis gigantea and early responses in Phaseolus vulgaris.
    Ms. Auanda B. Samarakoon. University of Guelph.

13. Growth regulators and assimilate transport.
    Dr. R.F. Horton and Ms. Judith Fregean. University of Guelph.

1. Root Cap structure in the fern, Ophioglossum. R.L. Peterson, Department of Botany and Genetics, University of Guelph, Guelph.

Information concerning the structure and function of root caps has been derived mainly from studies of angiosperm species. As part of a larger study on the ontogeny and structure of root caps of lower vascular plants, a correlated study of Ophioglossum root caps using techniques for light microscopy, transmission electron microscopy and scanning electron microscopy has been completed. Similarities between this root cap and those of angiosperms involve the differentiation of central cells with large amyloplasts (statoliths), and peripheral cells with thickened outer walls, active dictyosomes, and plastids with little starch. Differences include the presence of amyloplasts in immediate derivatives of the apical cells and the secretion of phenolic ompounds by peripheral cells. Fixation of root caps with glutaraldehyde-ferric chloride solutions and subsequent histochemistry or X-ray microanalysis suggests that dictyosome vesicles release these substances into the cell wall of the peripheral cells. The secreted phenolics may be important in preventing attacks by soil organisms.

2. Dengler, N.G. Department of Botany, University of Toronto, Toronto Ontario. The effect of light intensity on the processes of cell division and cell enlargement during leaf development.

One of the expressions of phenotypic plasticity characteristic of many plant species is the modification of leaf morphology and anatomy by light intensity. Normally, leaves which expand under low light intensities (shade leaves) differ from leaves grown under high light intensities (sun leaves) by having larger area, lower stomatal frequency, thinner lamina with less well-developed palisade and a higher proportion of intercellular space, a lower internal:external surface ratio, wider spacing between veins and larger epidermal cells with more undulate radial walls. With the exception of the limited work of Hughes (1959) on the shade plant, Impatiens parviflora, the developmental processes which give rise to these striking differences at maturity have not been documented. Unlike Impatiens parviflora, Helianthus annuus is a sun plant which shows little increase in leaf area ratio (leaf area/plant weight) in response to lowered light intensity; in fact leaf area is reduced. Our observations of the development of the second foliage leaf taken from plants grown under 100% and 25% full sun show that leaves grown under low light intensity have reduced mean leaf area (9 cm^2 v. 21.6 cm^2), increased ratio of leaf area to leaf weight (.58 v. .27) and reduced mean blade thickness (.220 mm v. .350 mm). The presence of a single palisade layer, reduced height of individual palisade cells and a reduction in the amount of intercellular space accounts for the reduced leaf thickness. Cell division appears to occur over a longer time period in the shade leaf; however cell number per unit leaf area is comparable for leaves grown under both conditions with the exception of the spongy mesophyll which has lower cell numbers. Both the rate and duration of cell enlargement, especially for the upper epidermis and palisade parenchyma, are greater in leaves growing in full sunlight; cell size in all cell layers is significantly reduced in leaves grown in low light intensity. Stomatal density in both the lower and upper epidermis is reduced in shade leaves. These and other observations indicate that a single environmental factor such as light intensity is able to influence both the rate and duration of the fudamental processes of cell division and enlargement, resulting in the phenotypic plasticity seen under field conditions.

3. Nuclear Growth in Root Cells during Germination of *Vicia faba*. Mr. J.E. Thomas, McMaster University.

In radicles of dormant seeds of *V. faba* most cells are arrested in G_1. During inhibition cells and nuclei are activated and they proceed through the cell cycle in a semi-synchronous wave; this phase of root growth occurs in the first 70 hr. Nuclear volumes and DNA contents per nucleus (expressed in arbitrary units) were determined. The following sequence of changes was seen: (1) 0-20 hr: nuclei were pleimorphic and increased in size. (2) At 20 hr. large, regular shaped nuclei were present and the mean nuclear volume was $954\mu m^3$. (3) 20-36 hr. (a) in slowly developing roots, most nuclei were in G_1 and S and very few cells were in mitosis. The mitotic index (M.I.) was 0.44. Mean nuclear volume was $503\mu m^3$. (b) in more rapidly developing roots, most of the nuclei were is S and G_2; mean nuclear volume was $1021\mu m^3$ and the M.I. was 1.95. (4) By 70 hr. meristems with a low M.I. had about 70% of cells in G_2 and even larger nuclei (mean nuclear volume was $1521\mu m^3$). It appears that in the long cycle leading up to the first mitosis, nuclei became regular in shape and increased in volume. During subsequent growth of the root, mean nuclear volumes gradually decreased.

Electrophoretic studies indicate that newpprotein bands appear in the meristem at about 36 hr. Their formation coincides with the increase in the mean nuclear volume at about that time.

4. Dr. U. Posluszny. Department of Botany and Genetics, University of Guelph, Guelph.

It has long been suspected that equal dichotomy of apical meristems occurs in angiosperms and may, in fact, be an alternative branching strategy. Unfortunately, evidence to conclusively demonstrate dichotomy has been difficult to obtain. Recently, Dr. P.B. Tomlinson of Harvard University, collected shoot tips of a monocotyledonous vine called *Flagellaria indica* which not only seems to branch dichotomously but does it at regular intervals. We were thus able to obtain critical stages showing dichotomous branching in the vegetative aerial shoots which were studied both three-dimentionally in whole buds and in histological sections. Initial stages in dichotomy involve broadening of the apex in the same plane as the distichously arranged leaves. Rapid upgrowth at the distal portions of the elongate apex results in two equal peaks which soon begin to initiate their own leaf primordia. These observations are not interpreted as being phylogenetically significant but are looked at as morphogenetic events that demonstrate the potential of the apical meristem. Further more analytical work on dichotomy in *Flagellaria indica* is planned and any suggestions as to possible experiments are welcomed.

5. Development of the endodermis in *Ranunculus*. Martha Scott, Department of Botany and Genetics. University of Guelph, Guelph.

The structure and ontogeny of the root endodermis of the dicot, *Ranunculus acris* was studied using a number of integrated techniques (LM.

TEM, SEM and histochemistry) in order to provide a basis of comparison with the monocot root endodermis. Successive root segments containing primary, secondary and tertiary stage endodermal cells were killed using a standard GA/OsO_4 fixation schedule with buffer PH and osmolatiy adjusted to obtain an optimal preservation of cytoplasm and membranes. Primary stage endodermal cells possess a distinct Casparian strip with a tightly adherent, thickened, tripartite plasma membrane. Addition of lipid-like droplets and membrane bound vesicles to the Casparian strip region is thought to be achieved through incorporation of paramural bodies into the plasma membrane. Cytoplasm of primary stage cells contains abundant organelles including active golgi apparati and electron dense lipid bodies. Secondary stage endodermal cells develop an extremely plastic suberin lamella which later become impregnated with electron dense "platelets" and granules. The mature endodermis of Ranunculus possesses an extensively thickened tertiary wall complex in which bands of cellulose, lignin and suberin alternate. Thiery positive vesicles of tertiary wall material are located between the suberin lamellae and the plasma membrane in Stage III cells. The suberin lamellae undergo considerable disruption and degradation in the vicinity of the Casparian strip. An active protoplast containing mitochondria, plastids, ribosomes and nuclei persists in mature tertiary stage cells. Intercellular spaces surrounding the endodermis, and vacuoles of adjacent cortical cells are found to be occluded with phenolics.

P.A.S. [illegible]
[illegible]
[illegible] lignin/suberin/[illegible]

Coop
positive in
Sudan II
Sudan B B

6. Development of Nitrogen-fixing Root Nodules. Wm. Newcomb, Department of Botany and Genetics. University of Guelph, Guelph.

Many leguminous plants form root nodules as a result of infection by various species of gram negative bacteria belonging to the genus Rhizobium. In addition, certain perennial non-leguminous plants, such as Alnus, Comptonia and Shepherdia, form root nodules containing actinomycetes (gram-positive bacteria having hyphal growth) of the genus Frankia. Initial development involves the invasion of a root hair by the microorganism and the subsequent stimulation of mitosis and sometimes endoreduplication in the root cortical cells. The endophyte eventually invades the recently divided cortical cells. In effective (capable of reducing molecular nitrogen) nodules the bacteria are always separated from the host cytoplasm by the plant plasma membrane and frequently an additional layer of cell wall material. Both the infected plant cell and the endophyte, undergo differentiation involving extensive cytological changes, eventually resulting in the mature nitrogen-fixing infected cell. Using LM, TEM, and SEM the development of nodules in the garden pea Pisum sativum and sweet fern, Comptonia peregrina will be compared and contrasted.

7. Differential Growth of Sister Nuclei in Binucleate Microspores of Tradescantia paludosa. R.L. White. Department of Biology, McMaster University, Hamilton.

Sister nuclei in binucleate cells offer two advantages for the study of the control of nuclear size: (1) they are formed at the same time and, therefore, are of the same age in the cell cycle. (2) they share a common cytoplasm and should be exposed to the same cytoplasmic influences.

Binucleate microspores were induced in *Trad. paludosa* using heat shocks; nuclear and cellular volumes were determined throughout microsporogenesis. It was found that cell and nuclear volumes of both uninucleate and binucleate cells, in the same anther, showed more or less parallel increases throughout interphase. However, the two sister nuclei of a binucleate cell rarely had identical volumes; in general, they showed large differences in their volumes and these were established in early G_1. This differential nuclear growth could reflect the presence of a cytoplasmic gradient; however, it seems unlikely that such a gradient could be maintained over a period of several days, i.e. the duration of this study. The results are interpreted as evidence that nuclear volume is, in part, controlled by factors that are: (1) present in nuclei; (2) not distributed equally at anaphase; (3) not rapidly exchanged between sister nuclei.

8. The ABPHYL syndrome in *Zea mays*. Patterns of leaf initiation and the shape of the shoot meristem. Richard I. Greyson, David B. Walden. Department of Plant Sciences, The University of Western Ontario.

It is axiomatic that the shoot apex is a region of continuing embryogeny from which leaf primordia and cells for internodal development arise. Phyllotaxy, therefore, is assumed to be a product of factors operating within this organizer region. It follows that phyllotactic variability represents modifications in the physiological and cellular processes of the apex and it might be expected that these could affect the gross morphological relationships in the meristem. Mathematical analyses of the meristem and phyllotaxy also assume that some architectural features must vary in some consistent manner though no uniform opinion exists as to what those features might be. As we reported ABPHYL is a new source of genetically based phyllotactic variability exhibiting a number of leaf arrangements. Individuals of this material exhibit varying degrees of helical (spiral), decussate and bijugate leaf arrangements as well as the normal distichous pattern. Microscopic cross-sections near the point of leaf initiation document that spiral and decussate leaf arrangements in ABPHYL specimens of seedling meristems also demonstrates that the spiral pattern is generated from meristems having diameters averaging 17% larger than comparably aged normal meristems. Two important conclusions can be drawn from these preliminary observations on the shoot meristem of ABPHYL corn. First, the altered phyllotactic patterns which we observed in ABPHYL plants are related, not surprisingly, to altered patterns of leaf initiation within the meristem itself. Second, a shift from distichous to spiral arrangement in the seedlings associated with a measureable difference in the size and shape of the meristem dome, is established. The significance of these observations to recent experimental and simulation studies will be discussed.

ABPHYLL

1,1 → 2,3

small diam → increased diam

Greyson
Walden
Lott
Davidson
Peterson
Kenneth
Podluckzy
Rauw (Guelph) plant
Lindsey (Guelph) physiology

phyllotaxy

Maksymowych GA treatment 2/3 → 3/5
accomp. by change in plastochron ratio
and diam increase

Schwabe 2/3 → 1/1 w. TIBA treatment

Mitchison computer simulation

Veen & Lindenmayer math. model to simulate all spiral phyllotaxies found

Temperatures

Scarb. College ?

transfer seedlings at 1st leaf stg

to growth chambers at 3 light intensities

check mature leaves for

cell size

cell number

9. Caffeine Effects on Cell Proliferation in roots of Vicia faba. S.W. Armstrong. Department of Biology, McMaster University. Hamilton.

After treatment with 5-aminouracil (5-AU) a partially synchronized wave of cells enter mitosis; during the period when these cells were in division roots were treated with 0.1% caffeine for 1 h. Binucleate cells were induced and they were studied as they progressed through the cell cycle. The results show that: (1) only 10% of the binucleate cells complete a cell cycle and divide again. (2) these cells are in division 12 and 14 h after caffeine treatment. (3) not only do the remaining 90% of binucleate cells not divide, but by 14 h they have not undergone DNA synthesis i.e. their nuclear DNA content is still at the G_1 level. (4) mean nuclear volume decreases from 1079 ± 403μm^3 1 h after caffeine treatment to 534 ± 203μm^3 after 14 h. (5) sister nuclei in binucleate cells differ in volume, indicating differential grwoth of sister nuclei in a common cytoplasm. Binucleate cells provide a system that is potentially useful in the analysis of nuclear-cytoplasmic interactions.

10. Phytotoxic burdens of heavy metal ions: relative tolerance in Agrostis gigantea and early responses in Phaseolus vulgaris. Wilfried E. Rauser, Gary D. Hogan and Anada B. Samarakoon, Department of Botany and Genetics, University of Guelph, Guelph, Ontario N1G 2W1.

Clones of Agrostis gigantea were assessed for their relative tolerance to excess metals. Two ecotypes (clones 4 and 6) originating from a mine waste site near Sudbury were compared to clone 14 of Agrostis gigantea grown from seed bred in Oregon in the abscence of metal contaminations. Clone 14 was assessed to be non-tolerant to excess Cu, Co, Ni and Zn. Clone 4 exhibited cotolerance to Cu, Co and Ni; clone 6 was tolerant to Ni; neither was tolerant to Zn. On the basis of root elongation growth, Cu was found to be most toxid followed by Ni, Co and Zn. The basis of Cu tolerance in clone 4 was examined in extensive comparisons with clone 6. Copper tolerance could not be attributed to differential binding of Cu to root cell walls nor to differential absorption and translocation of Cu.

White bean seedlings (Phaseolus vulgaris var. Kentwood) were exposed to excess Co, Ni or Zn in hydroponic cultures. Pulvinar function was blocked as shown by the abnormal orientation of unifoliolate leaves to a position closer to the vertical. This effect was evident within 4-6 hours. Two to four day exposures to excess metal caused abnormal accumulations of reducing sugars, sucrose and starch in leaves. Export of recently fixed carbon from unifoliolate leaves was reduced 2-5 fold below control after 2 days exposure to excess metal. All three metals caused a rise in soluble phenolics in leaves but not in the roots. Several new apolar components accentuated the marked qualitative changes in the soluble phenolics of leaves. The similarity of these diverse early responses elicited by Co, Ni and Zn suggests that each metal affects identical sites of metabolism.

11. Growth Regulators and Assimilate Transport. Roger F. Horton and Judith Fregeau, Department of Botany and Genetics, University of Guelph. Guelph.

Many investigations have attempted to relate the observation that meristematic regions of the plant, which may contain a relatively high level of auxin and other regulators, also act as sinks for the accumulation of phloem-mobile substances. Other parts of the plant, treated with auxin, will also act as sinks. Attempts have been made to define the mechanism of this Hormone Directed Transport, and it has been variously suggested that auxin acts by enhancing or at least maintaining sink activity, by stimulating the assimilate source by increasing photosynthesis, by altering loading or unloading of sieve tubes, or by effecting the phloem translocation itself. This last hypothesis has proved difficult to test directly, but we have attempted to do so by assessing the effects of assimilates from primary leaves of Phaseolus vulgaris. The leaves were allowed to exude in the dark from cut petioles after being exposed to $14CO_2$. EDTA was added to the collecting solution. This allowed exudation to continue for some hours. Most of the 14C was exuded as sucrose, with traces of glucose fructose and some unidentified compounds, probably amino acids.

Growth regulators were fed to the exuding leaf via the transpiration stream. This system allows us to establish the pattern of assimilate exudation from individual leaves before regulators are added so that (1) any direct effects of regulators on fixation rates are precluded. (2) regulators can enter the assimilatory and transport systems readily and (3) any rapid effects of regulators on the loading or transport system could be detected.

In this system, in which it could be shown that PCMBS inhibition could be relieved by glutathione, and both oubain and DNP could cause some inhibition only at 10^{-2}M, no effects of the regulators (auxin 50ppm, cytokinins 20ppm, abscisic acid 100ppm or gibberellins 50ppm) could be detected. It is concluded that hormone directed transport is not the result of rapid effects on the mechanism of phloem translocation.

A study of xylem vessels in elonegating and non-elongating regions of _Helianthus sp._ stem.

from Biology 338 (Plant Anatomy and Morphogenesis)
Biology Department, University of Waterloo
Ms. Carol Weerdenburg (technician) and Dr. Carol Peterson (Assistant Professor)

Objectives

There are four objectives on this study, first to locate the region of elongation in a _Helianthus_ sp. stem, second, to learn a simple maceration technique, third, to observe different types of secondary wall thickenings in xylem vessels, and fourth to observe the vessel types in non elongating and elongating regions of the stem.

Materials

The maceration fluid to be used consists of H_2O_2: dist H_2O: glacial acetic acid in a 1:4:5 ratio. .05% Toluidine Blue O in .1 M phosphate buffer pH=6.8 is used as a stain.

Methods

Week I

Obtain and label one _Helianthus sp._ plant (age three weeks). With the marker pen and ruler provided, mark the stem at 5 mm intervals for a total distance of 10 cm from the apex. Return the plant to greenhouse or growth chamber until next week.

Week II

Obtain the _Helianthus sp._ plant marked last week and remeasure the distance between the marks to locate regions of elongation and non-elongation. From your observations predict which region of the stem is _now_ undergoing rapid growth. Excise a 1 cm length of stem from the elongating region. Cut in half length wise, place it in a 20 ml screw cap vial, cover with 15-20 mls macerating fluid and cap. Excise a 1 cm length of stem from the non-elongating region and repeat the procedure. Place both vials in the warming oven (60°C) for 48 hrs. Store at room temperature until next week.

Week III

Recover the vials containing the _Helianthus_ sp. tissue in macerating fluid. With a pasteur pipette draw off the macerating fluid and discard. Rinse the tissue with two 10 ml changes of water. Draw off the final rinse and add just enough water to cover the tissue. Cap the vial tightly and shake vigorously until the tissue disassociates and no clumps remain. The maceration may be mounted directly or stained with toluidine Blue O for a few minutes before observation. The student is asked to report any difference in proportions of types of vessels between the two macerations and to explain the logic of any observed differences.

Results

The elongating zone of Helianthus sp. stem is that area of stem directly behind the apex. The maceration of this region shows annular and helical types of vessels in abundance. The maceration at the non-elongating zone shows all forms, annular, spiral, scalariform reticulate and pitted vessel types.

Discussion

The student learns to identify the various types of vessels; all types are present in Helianthus sp. The student should explain that the annular and spiral forms of (non-elongating) secondary wall deposition allow the primary cells to continue elongating, while other patterns of secondary wall deposition do not. Indirectly, the student also learns that cells which differentiate in the young region of the plant are retained in an older region, a concept that is surprising to some students.

Additional Remarks

This experiment can be performed on an individual basis by the student and requires relatively little glassware and chemicals. In our experience, the results have been reproducible.